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Trends in R&D and Standardization on Accessibility in the Information and Communications Field
— Toward Barrier-Free Equipment and Services of Information and Communications —

HAJIME YAMADA (*Affiliated Fellow*) AND TETSUYA YAMAZAKI
Information and Communications Research Unit

2.1 Introduction

Our everyday life is filled with a variety of devices and services of information and communications, ranging from PCs, personal digital assistants (PDAs) and Internet-enabled mobile phones to automatic teller machines (ATMs) at financial institutions, ticket-vending machines at train stations, kiosk information terminals for tourists and interactive digital satellite broadcasting TVs. As our society grows more information-oriented into the future, our lives will become increasingly dependent on such equipment and services.

Currently available devices and services, however, do not always provide ease of use for all possible users. The standard input method for the PC through a keyboard and mouse, for example, is not friendly to people with limb disabilities. Web pages containing many images also pose a challenge to people with vision impairments. Solving such problems is, in technical terms, referred to as "improving accessibility." Accessibility represents the product's ease of use and understanding for those who try to utilize it, which is similar to concepts such as "barrier-free information" and "universal access to information."

Typical groups that have poor accessibility are elderly and people with disabilities. However, they are not the only ones who are experiencing difficulty in operating information and communications devices such as PCs. Improved accessibility will have an impact on a greater range of users, and allow devices and services of information and communications to penetrate deeper into our daily lives. To realize a highly information-oriented society, improvement of accessibility is an inevitable task. This report focuses on the accessibility of equipment and services of information and communications, and presents trends in R&D and standardization activities in the field.

In relation to this subject, there is another approach in which accessibility is studied from the viewpoint of how information is created. Examples are research on a Web page structure that is easier to understand and research on a technique to select the necessary information from a large source and arrange the results to suit the user's needs. The former concerns the human's process of understanding information, while the latter is about how to enable machines to understand the meaning of information. As these studies are still in their early stages and have yet to develop, this report does not mention the issues of how to create information.

2.2 Accessibility market scale

There is no doubt that Japan is turning gray. According to the 2001 edition of the White Paper on the Aged Society, Japanese aged 65 years or older account for 17% of the entire national population and the figure is expected to top 25% in 10 years. Also, the statistics of the Ministry of Health, Labor and Welfare (MHLW) show that the number of adults and children with disabilities

totals to 3.34 million as of fiscal 2001.

Elderly and people with disabilities in legislative and statistical terms are defined based on certain criteria. In practice, however, there are people who face accessibility problems but do not meet the criteria. People with hearing difficulties, for example, are counted only when the person's hearing ability levels of both ears are 70dB or worse, whereas it is said that people often start experiencing difficulties in their everyday activities at around 40dB.

Even those who can use equipment and services of information and communications without any problems may experience inconvenience depending on his/her situation. Take a person with a broken arm, who is likely to feel uncomfortable dealing with a keyboard and mouse. Such people who have temporary disabilities should also be taken into consideration when discussing accessibility. If these people are added to the population of elderly and persons with disabilities, the total number of people with poor accessibility is enormous.

Discussions on accessibility for elderly and people with disabilities are often held from the standpoint of social welfare. Yet the target population is on the order of several tens of millions, when assuming the description above. This can be seen as a huge and certain market. In addition, given the massive population scale, it is not realistic to treat these people as a mere target of protection. Through improved accessibility to equipment and services of information and communications, elderly and people with disabilities will be encouraged to participate in society and their ability can be made good use of, both of which are essential to energize and develop the entire society.

2.3 Three approaches to improvement of accessibility

There are three approaches to improving the accessibility to equipment and services of information and communications:

The first approach is to have the person use a special aid suited for his or her disability to enhance the usability of equipment and services.

The second approach is to provide functions to change the input/output method or multiple input/output options, so that a person with any kind of difficulty can use the equipment or service. For PCs, some operating systems and popular software applications come options with such capabilities.

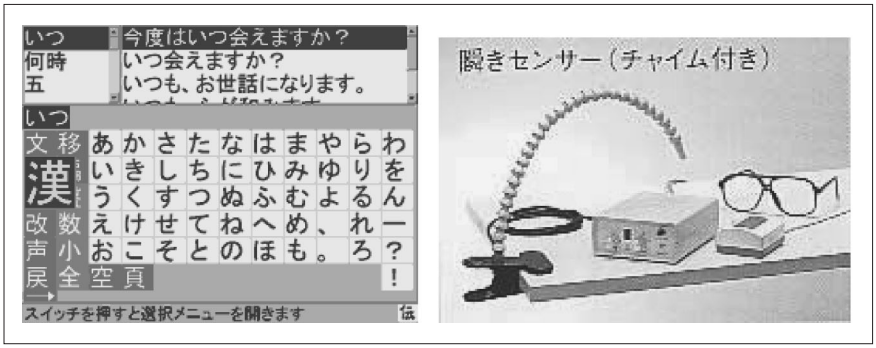
The third approach, an expansion of the second one, intends to ensure that accessibility is built into every information and communications device and service. In other words, this represents standardization of equipment and services. There are a number of activities under way throughout the world toward the development of standards on how to provide equipment and services of information and communications with consideration given to the needs of elderly and people with disabilities.

2.4 Trends in technological development

2.4.1 Current status of technological development

Here is an example of the first approach. People with amyotrophic lateral sclerosis (ALS) are profoundly disabled and have difficulty even speaking. To assist with their communication, a

Figure 1: A communication device designed for ALS patients ("Den-no-shin," Hitachi, Ltd.)



sensor system that can detect the movement of their eyes and eyelids (blinking), the parts of the body they can manage to move slightly, has been developed. The system displays a large table of characters on its screen on which the user can move the cursor through eye movements and select a character by blinking. Figure 1 shows a communication device designed for ALS patients.

Aside from this, a round-shaped push-type input device is offered to allow disabled persons who do not have sufficient muscular power to perform complicated operations to enter characters in Morse code. Other products available are software that enables the numeric keys to substitute for mouse operations and alternative technologies to the mouse such as track balls and touch panels. This is also the case with output devices. Text reading software, a program that generates audio output of Web pages, is a typical product in this area, in addition to Braille output devices (Braille displays and printers). These represent parts of the efforts to provide input/output devices specifically designed to address the needs of persons with varied types and levels of disabilities.

Many recent operating systems and software products for PCs permit users to change the view scale, the font size and color, background colors, the response speed of the keyboard and mouse, and so on. This can be viewed as an example of the second approach, since such functionality for customization improves accessibility for people with any kind of difficulty.

While the above cases are all related to PCs, they are not the only technology with poor accessibility. ATMs at post offices and banks, for example, now often employ touch panels, which are unfriendly to people with visual disabilities. To cope with the problem, models that accept entry from both the touch screen and keys have appeared. This move can be categorized into the second approach for its provision of alternative input/output methods. Yet, these ATMs still have plenty of room for improvement such as standardization of the key layout among different models.

Speech synthesis is used for communicating text information to people with hearing difficulties, while speech recognition technology is applied when communicating audio information to such people. The aforementioned Web text reading software exploits speech synthesis technology. The weakness here is that some Web pages contain two-dimensional information such as graphical images. Even a page consisting only of text may include a table, where the two-dimensional placement of text elements delivers significant information. How to communicate such complicated content is still in the stage of basic research. In NHK's news programs, the voice of announcers are automatically recognized and displayed as captions. While speech recognition works well where grammatically correct sentences are read with clear pronunciation, its function is not reliable in a conversation involving a number of people in a noisy environment. This is another fundamental research subject.

In Web text reading, audio output for a link to "http://www.nistep.go.jp," for instance, should not be literally pronounced, since it would be so long as to cause confusion and result in an unfriendly way of communication. A preferable sound for this element would be "a link to the National Institute of Science and Technology Policy," for which the creator of the Web page can prepare alternative HTML text in place. Likewise, an image should be accompanied by a text description. "Web Content Accessibility Guidelines 1.0," a document that explains how to create a highly accessible Web site, was published in 1999 by the Web Accessibility Initiative (WAI) committee of the World Wide Web Consortium (W3C), an international forum on Internet technologies, and has become the de facto international standard.

In Japan, in relation to this initiative, the Ministry of Posts and Telecommunications (MPT) and the Ministry of Health and Welfare (MHW) (both as they were called then) jointly issued in 1999 a guideline for the creation of Internet Web content accessible by people with disabilities based on the W3C guidelines. In a field trial on Web accessibility, the Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT) has been developing Web Helper, a system that allows Web site creators to check their sites' compatibility with this guideline and to make the necessary modifications semi-automatically. The program is slated for distribution to local public organizations by the end of 2002.

2.4.2 Government support for technological development

The Ministry of Economy, Trade and Industry (METI) has been promoting a program for the development of information systems for people with disabilities. The goal is to build, in the near future, an environment in which elderly and people with disabilities can actively take part in the information-oriented society by supporting the development and field/evaluation testing of information and communications equipment and systems friendly to such people.

The program rendered aid to 14 R&D projects in 2000, including "communications/telephone equipment for people with hearing/speech disabilities" and "PDA with Bluetooth interface for people with visual disabilities," and to another 14 projects in 2001, such as "development and field testing of e-mail software for disabled children with varied kanji reading skills" and "collection and utilization of barrier-free information through the application of IT technology." For 2002, "development and field testing of user-adaptive USB information input devices" (development of PDA-type input devices that can compensate for disabilities and be connected via USB) and "communication software for people with multiple disabilities (limbs and vision)" are among the eight projects which won grants. These are not large-scale projects, as the amount of grant per project is ¥30 million or less (may be raised up to ¥50 million depending on the content).

Developed in the project on "the communications/telephone device for people with hearing/speech disabilities" is a machine that has capabilities such as indicating an incoming call with a loud sound, vibration or lighting, letting the user choose a desirable communication method from either audio (voice) or text, for which a pen or keyboard is used, and adjustable audio volume and pitch. Through the "PDA with Bluetooth interface for people with visual disabilities" project, the participants have been working on the development of special hardware for people with vision impairments that has, instead of a regular PDA touch screen, a double-action keyboard that functions by first lightly pressing a key to produce a voice output of the assigned character or function, then firmly pressing the key to confirm entry.

A similar initiative has been taken by MHLW, which supports development of aids in the area of information and communications as part of the grant program for the development of welfare equipment carried out by the Association for Technical Aids, Inc. One of the three projects that earned the grant for 2002 was "research and development of a '3D mouse' that is easy and flexible to use for people with disabilities."

Furthermore, information on equipment and software that assist computer operations is available through such Web sites as "Kokoro Web (www.kokoroweb.org)," aided by METI, and "NORMANET (www.normanet.ne.jp)," supported by MHLW. One of the products listed on these sites is software featuring "word prediction" capabilities, a program designed for people having difficulty with keyboard typing. The software adds words and sentences entered by a user to its dictionary, so that the next time the person begins typing the same word or sentence, a box containing a list of selections appears when the first letter is entered.

2.5 Trends in standardization activities

2.5.1 Trends in ISO

In 1998, in response to a proposal from Japan, the Committee on Consumer Policy of the International Organization for Standardization (ISO) at its general meeting adopted a resolution to set up a task force for the development of a policy statement on general principles and guidelines for the design of products and environments addressing the needs of older persons and persons with disabilities. This is based on "universal design," a concept of making all facilities, products and services accessible to anybody, whether the person is or is not older or disabled. The working group, led by Japanese, actively carried out the task and finalized the general principles as the ISO/IEC Guide 71 (Guidelines for standards developers to address the needs of older persons and persons with disabilities) in early 2002. The document serves as a comprehensive guide, applying to all standardization activities.

Table 1: Development of guidelines in two technological fields

Information Processing Devices (led mainly by the MITI)	
1974-1976	Japan Electronic Industry Development Association (JEIDA) "Investigation of the Contribution Plan of Rehabilitation toward People with Disabilities"
1988	JEIDA "Investigation for the Preparation of Electronic Products Accessibility Guidelines"
1990	JEIDA "Computer Accessibility Guidelines"
1995	Notice No. 231 "Accessibility Guidelines for Use of Computers by People with Disabilities"
2000	Revision and announcement of "Accessibility Guidelines for Use of Computers by People with Disabilities and the Elderly"

Telecommunications Facilities (led mainly by the MPT)	
1998	Notice No. 515 " Accessibility Guidelines for Use of Telecommunication Equipment by People with Disabilities"
1998	Establishment of the "Telecommunication Access Council"
1999	MPT and MHW "Guidelines for the Creation of Internet Web Content Accessible by People with Disabilities"
2000	Telecommunication Access Council "Accessibility Guidelines for Use of Telecommunication Equipment by People with Disabilities"

Following this, ISO sought to develop accessibility standards to be met by every device and service in respective areas such as information and communications. As described later, there are a variety of ongoing activities in Japan as well, partly because of its intention to take the lead in the world by making technical proposals to ISO.

2.5.2 Trends in Japan

In Japan, separate guidelines have been established for information processing devices and telecommunications facilities as shown in Table 1.

Each guideline provides abstract requirements for equipment and services rather than concrete standard specifications. As an example, the Accessibility Guidelines for Use of Computers by People with Disabilities and the Elderly is outlined below.

(a) Promotion of the standardization of common functions

To address the wide range of barriers in the operation of equipment as far as possible, functions to be used in common should be standardized and built into general-purpose information processing devices. To be more specific, capabilities such as adjustable keyboard sensitivity, navigation through keys instead of a mouse (keyboard navigation) and adaptable response speed for mouse movement and clicking should be standardized and made available on all applications.

(b) Promotion of the development of dedicated functions

To eliminate operational barriers that are specific to individuals and are yet to be overcome only through existing common functions, special functions for further customization should be developed. More specifically, alternative devices such as a Braille keyboard and Braille display and voice input/output systems should be provided.

(c) Enhanced services

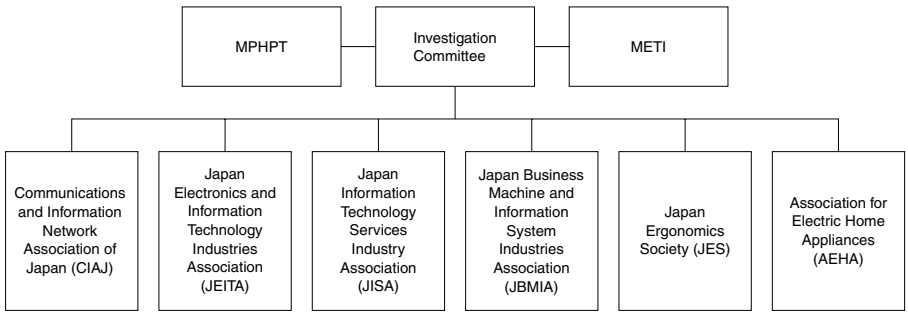
To encourage use of accessibility products and development of special functions, services should be enhanced for elderly or disabled users, their supporters, and developers of special functions. To be more specific, exposure of interface specifications to the public and creation of easier-to-understand content and manuals are demanded.

(d) Consideration to system openness

Emphasis should be placed on openness of systems to ensure compatibility, such as ease of connection with accessibility-conscious information processing devices commercially available.

Guidelines for information processing equipment and telecommunications facilities, which have been independently developed in each field, should preferably be consistent with

Figure 2: Structure of the Investigation Committee



each other as far as possible. The reason is because the distinction between information processing and telecommunications is becoming increasingly blurry with technological advancement, and also because products in compliance with close but different standards may confuse consumers.

It was 2000 when the activities toward the creation of common guidelines in the information and communications field were initiated. In September 2000, an internal organization of the Japan Standards Association, the Information Technology Research and Standardization Center (INSTAC), on a voluntary basis formed the Standardization Investigation Committee for Realizing Barrier-Free Access to Information. In response to the conclusion submitted by the committee, a new organization, the Standardization Investigation Committee for Improvement of Accessibility Common to Areas of Information Technology and Software Products, was established within INSTAC in April 2001 to serve as a body to carry out research entrusted by the government.

The new committee's structure, shown in Figure 2, shows various characteristics. The first point to be noted is that MPHPT and METI jointly support the activities. The fact that the committee has successfully acquired the understanding and cooperation of both ministries for its goal of providing Japan Industrial Standards (JIS) for elderly and people with disabilities is particularly noteworthy, considering the frequent disputes arising between ministries in Japan.

The second characteristic is participation of many organizations (industry associations, etc.) that have been engaged in the development of accessibility guidelines or in the promotion of relevant activities for the respective product groups.

In addition to these ministries and organizations, accessibility experts, people from enterprises, and disability groups comprise the committee. Currently, they are working toward the preparation of a draft JIS, which is expected to become a JIS standard by the spring of 2003.

Producing such JIS standard will contribute to wide availability of accessibility-conscious devices and services. In 1995, the government announced standard guides for the general evaluation and method of contracting of computers and services supplied to the government, as an agreement among the concerned ministries and agencies. Contained in the announcement is this sentence: "Items to be evaluated shall be established in conformity with the international and national standards." According to this rule, accessibility as a design consideration will become a requirement for government procurement, once the planned JIS standard is adopted. And if this effort by the government successfully expands the market, it is likely that the spread of such equipment and services will spark off interest in the private sector as well.

The JIS standard being prepared is a design guideline to be applied in common to all devices and services in the information and communications field and to be positioned above the existing guidelines for individual devices. After the adoption of the standard, guidelines in the respective areas will need to be reviewed in line with the common design guidelines and reestablished as JIS standards.

With respect to Web accessibility, as mentioned before, MPT and MHW (both are former name in that time) published in 1999 a guideline for the creation of Internet Web contents accessible by people with disabilities. Based on this document, a basic concept for providing administrative

information through electronic means was approved through inter-ministry meetings in 2001. Following this, Web sites of administrative organizations are required to conform to the guideline.

The JIS draft, which is slated to become a JIS standard by 2003, is being prepared in accordance with the above guideline on Web content creation as well as W3C guidelines.

2.5.3 Trends in the U.S.

In the U.S., the basic law stipulating the rights of people with disabilities was instituted in 1990 as the Americans with Disabilities Act. This law was epoch-making in that it abandoned the conventional protection-oriented welfare for people with disabilities and instead identified employment, accessibility and other rights of these people. The concept was reflected into the 1998 revision of the Rehabilitation Act. In the revision, an article was added to Section 508 requiring that information and communications equipment and services which purchased or leased by Federal agencies must be accessible to employees and citizens with disabilities. The newly revised Section 508 also stipulates that Federal agencies must ensure that device and services of information and communications they procure are accessible to employees and the public to the extent it does not pose an undue burden. And employees and citizens are permitted to file complaints regarding any lack of accessibility.

In other words, computers, software and office equipment procured by the government, as well as Web sites and services provided by the government, must be accessible to both employees and citizens. Since June 2001, the Federal government has been applying Section 508 to its procurement activities.

Accessibility standards in the U.S., published in 2000, are based on a concept similar to the one for the guidelines in Japan. The U.S. version is, however, more specific and broader, as it provides such details as the height and positioning of the navigation panel of an information kiosk to be used at an administrative organization to ensure accessibility for a person who uses a wheelchair.

Section 508 is bringing a significant change to industry in the U.S. Considering the enormous amount of procurement by the Federal government, U.S. companies have begun to think in this way: if accessibility is a requirement in the public sector, why not add accessibility to all products to be marketed? Even Japanese businesses, which are large exporters of information and communications equipment into the U.S., must address this issue.

When a standard is compulsory, all devices and services available throughout the country must be compliant with it. An example is a standard on how to ground electrical machinery, which was established to prevent electric shock. Since the U.S. accessibility standards, set in accordance with Section 508, are applicable only to Federal government procurement, it is not officially compulsory. However, due to the massive scale of its impact, U.S. firms have started considering the standard as semi-compulsory.

Furthermore, according to a hearing from the people who were involved in the development of the accessibility standards, the U.S. intends to "export" them worldwide to nations such as Canada and Mexico. While U.S. companies are advanced in accessibility, with their products and services compliant with Section 508, Japanese counterparts may not be ready for the change, a situation where the latter group may suffer considerable trade disadvantages.

There is a new movement in the U.S. after the launch of government procurement compatible with Section 508. It is a fresh approach in which individuals with disabilities are provided with a specifically designed input/output device, through which the person is given access to all devices and services of information and communications. Although its direction may be completely opposite to that of Section 508, this is an interesting initiative.

The activity is led by a group called the International Committee for Information Technology Standards. Their scheme is explained like this. As an interface between the personal input/output device and information equipment such as an ATM or ticket-vending machine, the Alternative Interface Access Protocol (AIAP) was developed. Via the protocol, communication is established between the input/output device and an external machine to which the user's request

can be transferred. An input/output device designed to assist each person's specific difficulties may be offered. Twenty leading companies in the information and communications industry participate in this project, and are ready to disseminate AIAP.

A critical question in developing an accessibility strategy is whether to make all equipment and services of information and communications accessible for everybody or to use intermediary devices customized to individual users for enabling their access to such equipment and services. The fact that the latter approach has started in the U.S., where the former approach was at one time dominant, may indicate the limitations of the former. The best solution is probably to improve accessibility of equipment and services as far as possible before further enhancing usability through intermediary devices.

2.5.4 Trends in Europe

In Europe, each nation's policy and the European Union's policy are interacting with each other to promote activities toward barrier-free information. The R&D program driven by the European Commission was launched in the 1990s, with a view to building a large accessibility market across Europe. Before the new movement, discussions were held solely from the viewpoint of equal opportunities, however, people began talking about technical aspects once the program started. The initiative also helped in calling attention to standardization.

Meanwhile, European efforts toward an information society were embodied as the eEurope plan. With the aim of giving special consideration to people with disabilities and acting against the digital divide, the plan requires the European Commission and each member state to identify the following actions.

The first action is to publish "Design for all" standards for information technology (IT) products by the end of 2002, in order to enhance employment opportunities for people with special needs and to encourage their participation in society. The second is to check whether laws and standards are compatible with the concept of accessibility by the end of 2001. In addition, eEurope also spells out improvements for public organizations' Web sites by the end of 2002, in line with the W3C guidelines.

With "Design for all" and "eAccessibility" as slogans, regional standardization bodies embarked on activities toward the development of guidelines in the area of information and communications. The European Commission, which asked for the movement, supports the activities with a small grant on the order of 10,000 Euro. The outcome is expected to be made public within 2002.

2.6 Provision of information to users and improvement of IT literacy

Before highly accessible equipment and services of information and communications can be disseminated, users must first know of their presence. Particularly important is to offer a place where people, especially elderly, who often express distaste for IT devices without ever trying or believe they cannot use such devices, can experience the benefits of such technologies and learn to accept them. Moreover, certain hands-on training should be provided, since, unfortunately, operating today's PC usually requires some getting use to. Education on threats such as computer viruses and exposure of personal information should also be given as needed. These are what "improvement of IT literacy" means.

For example, the mobile telephone is rapidly spreading among people with hearing difficulties. While at first these people did not show much interest in the technology, considering it as a kind of telephone, once they realized its capability of sending and receiving e-mail messages, the device started to prevail among them. This example suggests how important it is to provide information on the service itself.

In Japan, the e-Japan Program promotes education aiming at improvement of IT literacy. In this area, the program sets the following objectives.

(1) With the aim of far exceeding the forecast rate of 60% in 2005 for Internet penetration by individuals, information literacy of all Japanese shall be promoted.
(2) The IT education system in elementary,

Table 2: Structure of the Investigation Committee

Information Processing Devices (led mainly by the MITI)	
Initiatives	Number of Attendants
Basic IT skill training to learn the basics of operating PCs, making documents, accessing the Internet, and sending/receiving e-mails.	Approx. 5.5 million
IT training, etc., for managers of SMEs to understand the effects of IT on management.	Approx. 290,000
IT training, etc., for consumers to learn the skills to freely obtain and utilize information concerning everyday life.	Approx. 180,000
IT training, etc., at prefectural women's centers, etc.	Approx. 20,000
IT training, etc., for supporting corporate officers' planning of strategic information investment.	Approx. 15,000
IT training, etc., toward people working in agriculture, forestry and fisheries industries.	Approx. 10,000

lower- and upper-secondary schools and universities will be strengthened in addition to enhancing lifelong information education for the general public.

(3) By increasing the number of people with master's degrees and doctorates in IT-related fields, the availability of advanced IT technical experts and researchers shall be ensured in the private, academic and public sectors. In addition, some 30,000 distinguished foreign human resources will be accepted. In total, our nation will exceed the U.S. standard of human resources regarding IT technical experts and researchers.

To promote the understanding of IT among adults, the ministries concerned, including MPHPT, the Cabinet Office, METI and the Ministry of Agriculture, Forestry and Fisheries, have been implementing the measures as shown in Table 2.

Since improvement of IT literacy among older persons and people with disabilities is of the same importance, these people should be given opportunities to receive fundamental education on IT. he 2002 White Paper on "Information and Communications in Japan" mentions various ongoing efforts in this direction, such as seminars for these people. One such seminar is conducted by a group called Access Support Volunteer (ASV). The support offered by ASV includes: (1) on-site technical assistance, such as installation of text-to-speech synthesis software that works with on screen text and web pages, by dispatching a volunteer to the home of a sight-restricted person, (2) IT training for people with visual disabilities under commissions from local governments, and (3) monthly open consultations for people with visual disabilities.

Toward the future, it is hoped that even more educational opportunities will be offered to all citizens, including older persons and people with disabilities, to allow them to make the most of information and communications technologies.

2.7 Conclusion

In the domain of accessibility, Japan is behind the U.S., where accessibility as a requirement in government procurement has invigorated R&D even in the private sector and is leading to the emergence of new technologies such as AIAP. Japan and Europe stand almost at the same level, in a state an expert described as "proceeding, if at a snail's pace."

Thanks to the JIS and other standardization initiatives, the foundation on which highly accessible equipment and services can be spread is being secured. Wider availability of these products is expected to increase the user population, whose feedback will further improve the accessibility of the original equipment and services, resulting in a perpetual cycle.

One of the most effective first steps toward penetration is to adopt the coming JIS standard on accessibility as a consideration in procurement by the government, a high-volume purchaser of technology. This will give birth to a market through which accessibility-conscious devices and services can gradually spread into private markets.

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